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PRESENTED BY
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PRACTICAL DISINFECTION

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NOTE

THE disinfection of infected premises is as important as the maintenance of a quarantine during the prevalence of the disease. The virus of contagious and infectious diseases will often live for years. It is imperative therefore that the infected premises, with its contents, be thoroughly disinfected immediately after the death or recovery of the patient, in order to avoid a spread of the disease.

A disinfection performed in the manner recommended in this circular, will be thoroughly effective. The work, however, must be properly done, as directed, else the disease will remain in the house, a menace to the health and lives of those who enter. The health officer should never forget the fearful consequences which may follow a neglect in any particular of this important duty.

Disinfection should be performed by the city, village, township or county authority—(the latter in counties not under township organization only—in territory outside of cities and villages)—under the immediate direction of or by a qualified health officer, or physician or embalmer licensed by the State Board of Health.

"Whatever measures are adopted should be made thorough.

"Measures, good or bad, half done are worse than useless, as they give a fancied security."

RECOMMENDATIONS OF THE STATE BOARD OF HEALTH.

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PRACTICAL DISINFECTION

With the Results of Experimental Work Done in the Laboratory of the Illinois State Board of Heatlh, in Formaldehyde Disinfection.

GENERAL CONSIDERATIONS.

The object of disinfection in the sick room is the destruction of infectious material attached to clothing, carpets, draperies, furniture or surfaces of the room, or deposited as dust upon the window ledges, in crevices, cracks and other more or less inaccessible parts of the room. If the room has been properly cleaned and ventilated while still occupied by the sick person, and especially if it was stripped of carpets and unnecessary furniture at the onset of the attack, the difficulties of disinfection will be greatly reduced.

The work of disinfection should begin with the beginning of the treatment and should continue during the whole course of the disease. All articles of bed clothing and of body clothing should be disinfected as soon as they are removed from the bed or from the patient.

The liberal use of liquid disinfectants composed of chloride of lime, carbolic acid, or corrosive sublimate is strongly recommended in the sick room, but there should be no attempt to disinfect the room by any vapors or gases when occupied by the patient. This can not be accomplished. Fresh air, combined with absolute cleanliness, is the disinfectant most needed in the sick room.

During the entire illness, the privy should be thoroughly disinfected with Standard Disinfectant No. 1, (see page 21) four or five gallons of which should be thrown into the vault every day. Instead of the solution, chloride of lime in powder can be used. All woodwork in the vault should be soaked with the solution or covered with powdered lime. Water closets and sinks should be disinfected daily by pouring a quart or more of the solution of chloride of lime or carbolic acid into the pipes. The pipes should be freely flushed in order to avoid injury.

As unsanitary surroundings and uncleanliness will tend to retard the recovery of the patient, every effort should be made to keep the house, cellar, outhouses and yard clean. The cellar should be freed of all rubbish and decaying matter and the walls whitewashed. All rubbish and decaying matter should be burned. Quicklime, Standard Disinfectant No. 4, (see page 21) can be well used to whitewash exposed surfaces and to disinfect sinks, drains, decaying matter too wet to be burned, pools of water, etc. Attempts should be made to draw off all pools of water.

In the disinfection of houses which have been occupied by those suffering from contagious or dangerously communicable diseases, much can be accomplished by the liberal use of liquid disinfectants, by thoroughly washing all woodwork and exposed surfaces, by the burning of mattresses and pillows, by the removal of wall paper after saturation with disinfectants, and by treating carpets, hangings and other fabrics and exposing them in the fresh air and to sunlight.

The ideal disinfection would be one which would have no destructive effect upon the contents of the room, which would have such penetrating power as to be effective upon all infectious material however inaccessible they might be and which could be applied with a minimum of labor. Such a disinfectant has never been found. Gases are decidedly limited as to penetrating power and are suited only for comparatively superficial disinfection. Liquid disinfectants are unavailable for many uses. It is consequently essential that we adopt both the aerial and the liquid disinfectants and that we give such attention to every detail that no article and no part of the room escape being subjected to the suitable disinfecting agent in the most advantageous way.

AERIAL DISINFECTION.

The most effective part of house disinfection, however, is accomplished by the liberation of large quantities of disinfecting and germicidal gases, which impregnate the air, saturate the softer fabrics, and invade the most inaccessible and remote parts of the room. For this aerial disinfection the fumes of burning sulphur were formerly accepted by all health officers and sanitarians, but in more recent years formaldehyde gas has been used and exploited and has acquired a high degree of popularity.

Whatever the agent used for aerial disinfection with fumes or gases the following certain general rules are essential to success, and may be laid down for adoption both by those who adhere to sulphur as the disinfecting agent and by those who prefer and use formaldehyde gas.

(*a*) Have all windows and doors (except doors of egress) tightly closed. Securely paste strips of paper over keyholes, over all cracks, above, beneath and at sides of windows and doors, over stove holes, and all openings in walls, ceiling and floor. If the opening be large, paste several thicknesses of paper over it. Carefully stop up the fireplace, if there be one. There must be no opening through which gas can escape.

(*b*) All articles in the room that can not be washed should be spread out on chairs or racks. Clothing, bed covers, etc., should be hung on lines stretched across the room. Mattresses should be opened and set on edge. Window shades and curtains should be spread out at full length. If there is a trunk or chest in the room, open it, but let nothing stay in it. Open the pillows so that the sulphur or formaldehyde fumes can reach the feathers. Do not pile articles together.

(*c*) After the aerial disinfection is completed and the room opened, take out all articles and place them in the sunshine. Carpets should be well beaten and exposed to the sun.

(*d*) All wood surfaces in the room should then be thoroughly washed with Standard Disinfectant No. 3. (see page 21). Wash well all out of-the-way places, window ledges, mouldings, etc. Floors particularly should receive careful attention and the solution should wet the dust and dirt in the cracks. If the walls are papered, soak the paper with the solution and have it removed.

(*e*) After washing, ventilate the rooms, if possible for several hours, then scrub all woodwork with soap and hot water.

(*f*) It is safer to burn mattresses and pillows.

(*g*) It is likewise safer to burn all books, toys and articles of little value which have been handled by the patient. Burn what you cannot boil or thoroughly wash. Books which have not been handled by the patient can be saved. Lay them on edge of a table with leaves open, in room while sulphur fumes or formaldehyde gases are being generated.

It must be borne in mind that thoroughness of application is most essential, whatever method of disinfection may be adopted. Carelessness in the slightest detail may be productive of the gravest danger to those whose confidence has been inspired by the assurances of safety.

Although the patient suffering from contagious disease may have been confined to one room, it must not be forgotten that the avenues for the transmission of infective material to other parts of the house are never entirely shut off so long as there is any communication between the sickroom and other rooms. Even the sheet, saturated with liquid disinfectants, which experience has taught us to hang over the open door of the sickroom, may not serve as a barrier to all infectious material, especially if the nurse, the physician and members of the family pass frequently from the sickroom to other parts of the house. Hence, after cases of particularly contagious nature, not only the sickroom but all rooms contiguous to it should be thoroughly disinfected.

SULPHUR DISINFECTION.

Disinfection by the burning of sulphur has been successfully practiced for many years. As stated by Surgeon General Sternberg, United States Army, "the experience of sanitarians is in favor of its use in yellow fever, small-pox, scarlet fever, diphtheria and other diseases in which there is reason to believe that the infectious material does not contain spores." This method of disinfection has also been endorsed recently by the United States Marine Hospital Service, after numerous experiments, during which the efficacy of sulphur disinfection, in the presence of moisture, was conclusively proven.

The results obtained by the Illinois State Board of Health, in the several experiments made, have been directly in line with those of other investigators. The burning of sulphur in the presence of moisture has been found an effectual method of gaseous disinfection, and one upon which entire dependence can be placed at all times in disinfection after diseases due to micro-organisms not containing spores.

After the preparation of the room, as described on page 3, reliable and cheap disinfection may be secured by the following method of the use of sulphur.

(1) Use four pounds of powered sulphur for every 1,000 cubic feet in the room. A room ten feet long, ten feet wide and ten feet high has 1,000 cubic feet. For a large closet use two pounds of sulphur.

(2) Burn the sulphur in an iron pot or deep pan. Let the pot or pan stand in a larger vessel containing water, which vessel should be placed on a table, not on the floor. For example, take a common wash tub, lay in it three or four bricks, pour in boiling water to the level of tops of bricks, put the pot or pan containing the required amount of sulphur on the bricks, place the washtub and contents on a table. The disinfecting "apparatus" is then in working order.

(3) Moisten the sulphur with alcohol and ignite. When the sulphur begins to burn, leave the room, close the door of egress, and carefully paste strips of paper over the keyhole and all openings above, beneath and at sides of door. Keep the room closed for ten hours at least, twenty-four if possible.

Sulphur candles can be used instead of crude sulphur, but care must be taken to use sufficient candles. The average candle on the market contains one pound of sulphur. Four of these will be required in the disinfection of a small room 10x10x10. Do not use a less number, no matter what directions may accompany the candle. The water-jacketed candle is preferable. Partly fill tin around candle with water and place candles in a pan on the table, not on the floor. Let at least one-half pint of water be vaporized with each candle. In the absence of moisture, the fumes of sulphur have no disinfecting power.

There is, however, one serious objection to the use of sulphur, and this must be fully understood. The fumes of sulphur have a destructive action on the fabrics of wool, silk, cotton and linen, on tapestries and draperies, and exercise an injurious influence on brass, copper, steel and gilt work. Colored fabrics are frequently changed in appearance and the strength impaired. Fabrics, however, can be effectually disinfected by hanging them on a line exposed to the sun and wind for several days. Curtains and all articles of cotton or linen, boiling or soaking them in Standard Disinfectant No. 3, (see page 21) for several hours, and portable articles of brass, copper, steel and gilt-work by washing with a strong solution of carbolic acid (Standard Disinfectant No. 1). Colored fabrics which have been in a room during disinfection should be immediately exposed to the sun and wind. Uncolored fabrics which will not be injured by moisture should be at once soaked in water. This action will prevent further injurious action of the sulphuric acid.

Sulphur will be found a thoroughly reliable gaseous disinfectant of considerable penetrating power, if it is intelligently employed. To obtain satisfactory results, the following essentials of successful disinfection, established by repeated experiments, must be observed: (*a*) The infected room, or rooms, must be thoroughly closed, every crack and crevice sealed. (*b*) Sufficient sulphur must be used. (*c*) The time of exposure must be sufficient, ten hours the minimum.

In the disinfection of stores, halls, school houses and apartments or dwellings in which there are no articles to be injuriously affected by the gas, sulphur is an ideal disinfectant. Its mode of application is simple (the simpler the mode of application the better), it is cheap, the material is accessible everywhere, and, finally, the most important of all, the action will be invariably found effective when the sulphur is properly used.

FORMALDEHYDE DISINFECTION.

On account of the destructive properties of sulphur, efforts have been made to find a satisfactory substitute for this agent, one of equal germicidal power, which will not damage the contents of the room. If dependence could be placed on the published results of innumerable experiments made with formaldehyde, there would be no necessity for further search for the much desired substitute. Formaldehyde has been lauded as the most powerful sterilizier and germicide known; as a gaseous disinfectant far superior in efficiency to sulphur—one seemingly without limitations, effective at all times. The results obtained by careful observers in experiments made, not in laboratories, but in dwelling houses, shops and railroad cars, in which disease is often found, do not substantiate the extravagant claims made for formaldehyde. That it has no action on copper, brass, nickel, silver, steel or other metals and causes no diminution in the strength of cloth, was early discovered and it has been claimed in its favor, that it has no bleaching action and no effect upon colored fabrics except to intensify somewhat the effect of some of the coal tar dyes. It is entirely harmless to clothing, furs, articles of rubber, leather, paper, paintings, woodwork or furniture.

Formaldehyde (otherwise known as methyl aldehyde, formicaldehyde and "formalin") exists in several forms, but is principally known as a gas, but its germicidal properties were not recognized until 1886, and were not put to use until 1890. The formaldehyde gas is the vapor of wood alcohol which has undergone a chemical change. The gas is produced by passing the vapor of wood alcohol over platinum or plantinized carbon in an incandescent state. Many portable apparatus for the production of formaldehyde gas directly from wood alcohol have been devised during the past seven or eight years. The writer made a series of experiments in 1896-7 with the generators then on the market. The tests were conducted in the most painstaking and careful manner, but in every instance the results were unsatisfactory. It was found that the generators did not give off sufficient formaldehyde; that the alcohol was generated too slowly, and that large quantities of alcohol passed through the generator unchanged. There was consequently no disinfection. Few, if any of these generators so highly endorsed in 1896 as ideal apparatus for the production of formaldehyde gas, are now offered for sale.

The aqueous solution of formaldehyde gas, known as formaldehyde and as formalin, is a 40 per cent solution of the gas formaldehyde in water. It is claimed that many of the commercial preparations do not contain 40 per cent of formaldehyde. The concentration of the solution can not exceed 40 per cent. This preparation, if properly made, is a powerful bactericide and is preferable to corrosive sublimate as a germicide, cost not considered, although it is much slower in action. Several processes have been devised for the liberation of formaldehyde gas from its watery solution. The solution when exposed to the air gives off a considerable quantity of the gas, especially when sprayed on large surfaces. If the solution be sprayed on blankets or sheets or articles of clothing hung in the room or on the walls, the liberation of the gas will be so rapid as to compel the operator to leave the room. These facts have given rise to the belief that exposure of the gas in this manner will be sufficient to cause disinfection. The results, however, do not confirm this. There is much uncertainty as to the amount of gas which is evolved, and the behavior of the gas is at times very capricious.

The Illinois State Board of Health conducted several experiments during the years 1899-1901 with the so-called "sheet method" of disinfection, which consists in suspending sheets in the infected room and spraying them with the watery solution of the gas, using about six ounces of the 40 per cent solution to each 1,000 cubic feet of air space. The results have not been satisfactory. At times this method proved effective, while again under almost similar conditions it was found worthless, even when the amount of formaldehyde was increased. The action of the gas in this process is modified by some conditions not clearly understood, but there is little doubt that the relative humidity of the atmosphere and the temperature of the room are the main controlling factors in this and all other methods of applying formaldehyde gas. It has been frequently found that the quantity of the gas liberated is insufficient, and that the gas given off from the solution is often deposited as paraform, which at ordinary temperatures is useless as a disinfectant.

This has been frequently proven in the experiments conducted by the Board. This uncertainty of action must necessarily serve as a warning not to rely on this method of disinfection. The method, furthermore, has been found exceedingly difficult of application. It is absolutely necessary, in order to obtain satisfactory results, that the solution be sprayed evenly on the sheet in small drops. As the gas effects the eyes and air passages of the operator, the average disinfector will not take the precautions required.

As this method, which has been highly lauded by some health authorities and as strongly condemned by others, has proven so unreliable in the repeated tests conducted since the summer of 1899, the State Board of Health cannot consistently recommend its use to physicians and health authorities: "An effective method of disinfection must have no exceptions; it must invariably kill."

The most common method of obtaining formaldehyde gas from the watery solution at the present time is by means of apparatus designed to regenerate the gas by boiling the solution under pressure. Many generators operating on this principle are to be found on the market. Several of these are complicated machines requiring skill to properly operate. As some of the generators require constant attention, it has been found necessary to place them outside of the apartment being disinfected and to pass the gas into the room by means of a tube run through a keyhole. The diffusion of the gas produced in this way is slow, particularly in large areas, tending to its concentration at a few points and to the formation of paraformaldehyde. This method of disinfection cannot be recommended.

With the Schering method of disinfection, which consists in the rapid evaporation of paraform pastilles, said to contain 100 per cent of pure formaldehyde, many tests have been made by the State Board of Health during the past five years. The results were generally satisfactory, when the gases envolved were thoroughly mixed with the watery vapor. This method, however, is expensive; much care must be used in the working of the generator, and it has been found very difficult after disinfection to rid the premises of the gas. In one of the experiments the vapor ignited. The experiments were conducted with the Schering formalin disinfector (not the lamp) manufactured by Schering & Glatz, New York.

Formaldehyde candles which are composed of a variable amount of paraformaldehyde, pressed in cylindrical form in a tin container, are now offered to physicians and health authorities as a means of disinfection. It is claimed that, by burning the paraform, the heat produced causes the solid to revert to the gaseous form. No dependence whatever should be placed on these candles.

The evaporation of the solution of formaldehyde by means of heat in an ordinary kettle is one of the simplest methods of disinfection with formaldehyde, and as a result have proven the most effective. This is termed the Breslau method. Many health authorities have testified its efficiency during the past seven years

To quote from the monthly report of the Chicago Health Department of January, 1898, in which this process is described at length and heartily endorsed: "A six hours' exposure under these conditions has given better results in the sterilization of cultures than has been obtained by any other method, and the other requirements—of simplicity and portability of apparatus, rapid evolution of the disinfecting agent and brief duration of exposure, together with reasonable cost of disinfection—are very nearly met."

A very simple apparatus for disinfection by this method was devised by the Health Department of St. Louis in 1898. This consists of a copper kettle for the disinfectant, a tripod, and a copper vessel containing mineral wool for the alcohol. When the apparatus is placed in order the kettle is partly filled with hot water and the alcohol in the vessel beneath is ignited. As soon as the water boils there is poured into the kettle a quantity of the 40 per cent solution of formaldehyde, forty ounces being sufficient for the disinfection of 2,000 cubic feet of air space. In order to produce sufficient moisture, there is used in addition a similar apparatus in which water alone is boiled. The Illinois State Board of Health has conducted many experiments with this apparatus, and the results have been generally satisfactory, and it is evident that the apparatus, when properly used, can be relied upon to produce a proper amount of formaldehyde gas of the highest efficiency. After repeated tests made at intervals from 1899 to 1901, the State Board of Health feels justified in recommending this method of disinfection with formaldehyde to physicians and health authorities, under ordinary conditions of temperature and humidity.

To obtain proper results with this or any other apparatus it is absolutely necessary that the best formaldehyde or formalin be obtained. Much of the formaldehyde sold in the United States under different names can not be relied upon. To be effective formaldehyde must contain not less than 38 per cent of strength. There is also much difference in the quality of wood alcohol found on the market. Alcohol. 95 per cent proof must be used in this apparatus.

In disinfection with formaldehyde the same precautions relative to the sealing of the room must be taken as in disinfection with sulphur. It must be borne in mind also that the gas of formaldehyde, unlike that of sulphur, has but feeble penetrating power. There is no doubt, however, that the gas of formaldehyde will penetrate wherever infection has been carried by the surrounding atmosphere.

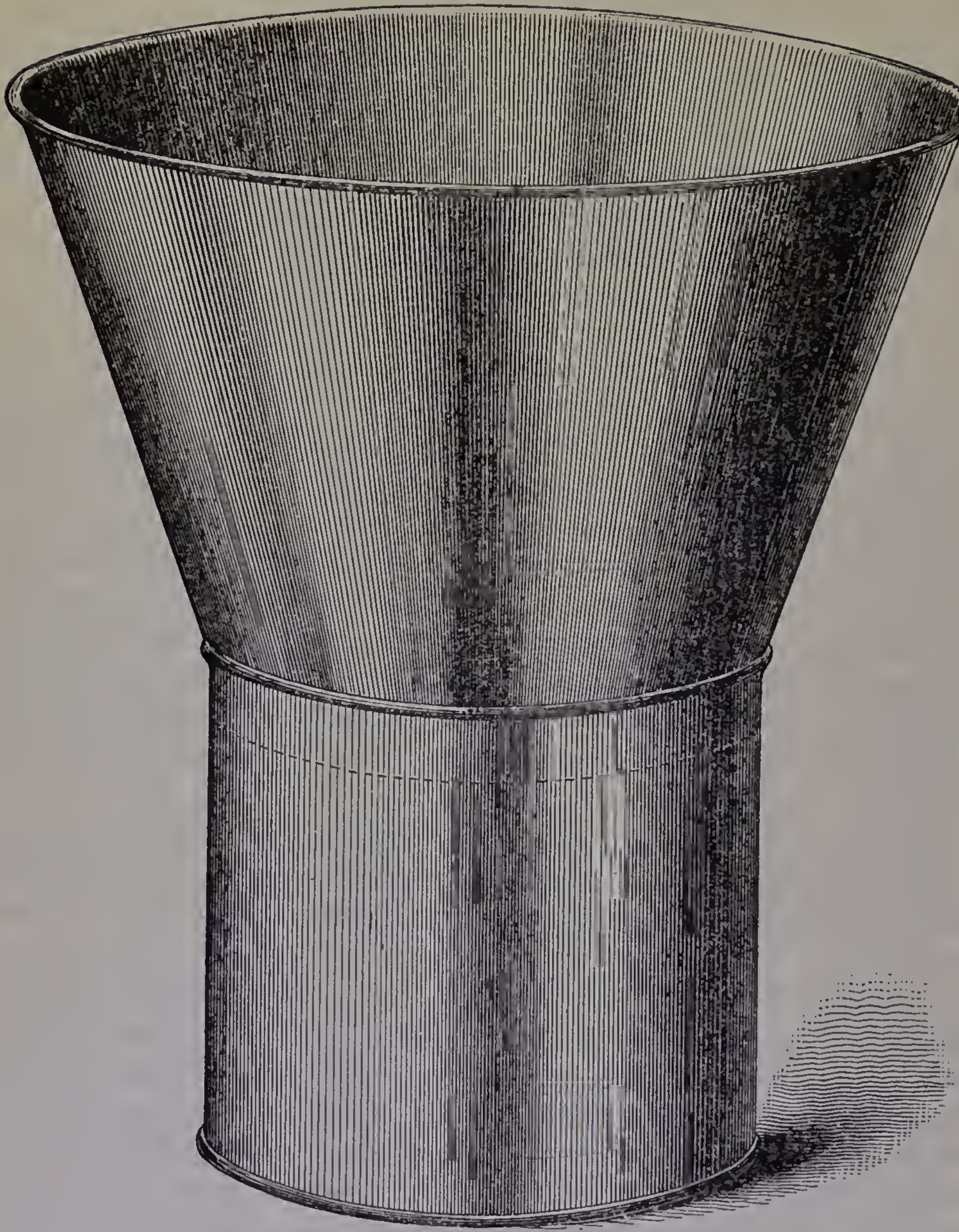
THE FORMALDEHYDE AND POTASSIUM PERMANGANATE METHOD OF GENERATING FORMALDEHYDE GAS.

While the results obtained with some of the methods of formaldehyde disinfection formerly suggested have been generally satisfactory, failures were at times experienced when the conditions were apparently ideal, while under unfavorable conditions of temperature and humidity, ineffective disinfection was of frequent occurrence. For this reason, while placing before the physicians and health officers of the State the best methods of formaldehyde disinfection, the State Board of Health has continued to advocate sulphur for aerial disinfection as the only agency which had demonstrated beyond question its efficiency and reliability at all times.

Aside from the uncertainty of results of the methods of formaldehyde disinfection offered for use, the apparatus has often been complicated in operation, unnecessarily expensive and dangerous as to the destruction of property by fire.

An exceedingly simple method of generating the gas by pouring formaldehyde solution over the crystals of potassium permanganate in an open vessel, has been more recently suggested and gives promise of overcoming the objections which have stood in the way of the more general adoption of formaldehyde as a disinfecting agent. This method primarily offered the advantages of absolute simplicity in operation, requiring no special apparatus and no fire. In addition to this, exhaustive experimental work has demonstrated that, in practical disinfection, the method is unusually efficient, the effectiveness seeming to depend less upon the conditions of humidity and temperature than that of any other method.

The only apparatus required is a large open vessel, protected by some non-conductive material to preserve the heat within. An ordinary milk-pail, set into a pulp or wooden bucket will answer



DISINFECTING APPARATUS.

(Designed by the Maine State Board of Health.)

Height, 15½ inches; height of lower portion, 8 inches; diameter at top, 17½ inches; diameter at base, 10 inches. Made of bright tin and covered with asbestos paper.

every purpose, although a special container, devised for physicians and health officers, will be found of considerable advantage. This container or generator consists of a simply constructed tin can with broad flaring top. Its full height is 15½ inches, the height to the flaring or funnel-shaped top being about 8 inches. The lower or round section is 10 inches in diameter while the funnel top is 17½ inches in diameter at the top. This container is made of a good quality of tin, is supplied with a double bottom with ¼ inch air space between the layers of tin, and is entirely covered on the outside with asbestos paper. The asbestos paper and double bottom serve to effectively retain the heat which is generated by the vigorous chemical reaction occurring within the generator and which is essential to the complete production and liberation of the gas. The special container can be made by any tinner of ordinary intelligence and costs but a few dollars.

With the room sealed, as described on page 5, and as is essential to any form of aerial disinfection, the crystals of potassium permanganate (3½ ounces to each 1,000 cubic feet of air space) are placed in the container. Over this salt is poured "formalin" or the 40 per cent aqueous solution of formaldehyde (1 pint for every 1,000 cubic feet of air space). The formaldehyde gas is promptly liberated by the vigorous chemical reaction of the formalin and the potassic salt and rises from the generator in immense volume in the form of an inverted cone. It is consequently essential that all preparations be made in advance and that the operator leave the room at once on the combination of the two chemicals.

The doors or windows of exit will be promptly closed and sealed and the room will be left closed for at least six hours.

The results obtained by this method, in experiments conducted in the laboratories of the Illinois State Board of Health, under varying atmospheric conditions and with a rather wide range of temperature, prove the method peculiarly effective while the simplicity of the operation, the small expense of the apparatus, (in fact, its successful operation without apparatus of any kind if necessary), and the moderate cost of operation, serve to commend it. The average cost of 3½ ounces of permanganate of potassium is about 25 cents and of 1 pint of good *formaldehyde solution, about 50 cents, making the cost of disinfection of 1,000 cubic feet of air space about 75 cents.

This method was first suggested in 1902–3, but it was given no publicity until 1904, when it was described by Dr. G. A. John-

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*See page 12.

son, of Sioux City, Iowa, in a paper read before the Sioux Valley Medical Association. Even then it attracted very little attention and was not subjected to systematic tests until late in 1904, when numerous bacteriological tests were made by the State Board of Health of Maine.

During the summer and autumn of 1905 exhaustive experimental investigations were carried on with this method of disinfection in the Laboratories of the Illinois State Board of Health, at Springfield. An ordinary office-room, containing 1,080 cubic feet of air space, was secured situated conveniently to the laboratory. The door was carefully sealed with strips of gummed paper and access to the room was gained through an outer window. This window was not protected by paper strips but set closely in its frame.

Cultures of various forms of bacteria were prepared by saturating strips of milk paper, (½ inch by 2 inches) in pure cultures for a period of 24 hours. These culture slips were secured in pairs, one of the slips being exposed in the room, while the other was sealed in a sterilized, labeled envelope and retained in the laboratory as a control culture. After the exposure of the first slip to the formaldehyde gas, generated by the pouring of formaldehyde solution over permanganate of potassium in the usual way, it was returned to the laboratory and the two slips placed in the incubator and later examined and compared.

On account of the variable results obtained by other methods of formaldehyde disinfection, depending largely upon the temperature and atmospheric conditions, days were selected for experimental work which varied greatly in temperature, humidity, cloudiness and other climatic conditions and these conditions were made a part of the laboratory records.

Specimens were exposed for periods of six hours and, between experiments, the room was left open that it might be entirely freed of any traces of formaldehyde gas.

The results of experiments in the Laboratory of the Illinois State Board of Health are shown in the tables on the following pages:

Number of Experiment.	WEATHER.	AMOUNT CHEMICALS USED.	*Mean Temperature.	Bacillus Coli Communis.	Bacillus Typhosus.	Bacillus Prodigiosus.	Bacillus Anthracis.	Pneumococcus.	Streptococcus.	Staphy-Pyogenes Albus.	Staphy-Pyogenes Aures.	Staphy-Pyogenes Citreus.	Bacillus Subtilis.
1	Precip. 0 Clear	Pot. Perm. 6.66 oz. Formalin, 2 pints	84 F R. 82 F	Neg.	Neg.	Neg.	Neg.	......	......	......	......	......	......
2	Precip. .12 Partly cloudy	Pot. Perm. 6.66 oz. Formalin, 2 pints	83 F R. 81 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	......
3	Precip. Trace Cloudy	Pot. Perm. 6,66 oz. Formalin, 2 pints	78 F R. 80 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	......
4	Precip. Trace Partly cloudy	Pot. Perm. 6.66 oz. Formalin, 2 pints	72 F R. 76 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	......
5	Precip. 0 Partly cloudy	Pot. Perm. 6.66 oz. Formalin, 2 pints	73 F R. 75 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	......
6	Precip. 0 Partly cloudy	Pot. Perm. 6.66 oz. Formalin, 2 pints	70 R. 75 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
7	Precip. .01 Cloudy	Pot. Perm. 6.66 oz. Formalin, 2 pints	69 R. 71 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
8	Precip. .07 Cloudy	Pot. Perm. 6.66 oz. Formalin, 2 pints	70 R. 68 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
9	Precip. 0 Partly cloudy	Pot. Perm. 6.66 oz. Formalin, 2 pints	73 R. 69 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
10	Precip. 0 Clear	Pot. Perm. 6.66 oz. Formalin, 2 pints	72 R. 73 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
11	Precip. 1.53 Cloudy	Pot. Perm. 6.66 oz. Formalin, 2 pints	71 F R. 70 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
12	Precip. 0 Clear	Pot. Perm. 6.66 oz. Formalin, 2 pints	77 F R. 75 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
13	Precip. 0 Clear	Pot. Perm. 6.66 oz. Formalin, 2 pints	78 F R. 78 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
14	Precip. 0 Clear	Pot. Perm. 6.66 oz. Formalin, 2 pints	78 F R. 76 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
15	Precip. 0 Partly cloudy	Pot. Perm. 6.66 oz. Formalin, 2 pints	82 F R. 80 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
16	Precip. 0 Clear	Pot. Perm. 5 oz. Formalin, 1.5 pints	77 F R. 76 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
17	Precip. Trace Partly cloudy	Pot. Perm. 5 oz. Formalin, 1.5 pints	70 F R. 77 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
18	Precip. Trace Partly cloudy	Pot. Perm. 5 oz. Formalin, 1.5 pints	70 F R. 76 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.

*Temperature indicated by "R" is the temperature of the room.
Temperature first given is out-of-door temperature.

Number of Experiment.	WEATHER	AMOUNT CHEMICALS USED.	*Mean Temperature.	Bacillus Coli Communis.	Bacillus Typhosus.	Bacillus Prodigiosus.	Bacillus Anthracis.	Pneumococcus.	Streptococcus.	Staphy-Pyogenes Albus.	Staphy-Pyogenes Aures.	Staphy-Pyogenes Citreus.	Bacillus Subtilis.
19	Precip. 0 Clear	Pot. Perm. 5 oz Formalin, 1.5 pints	76 F R. 75 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
20	Precip. .22 Partly cloudy	Pot. Perm. 5 oz Formalin, 1.5 pints	67 F R. 78 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
21	Precip. .21 Cloudy	Pot. Perm. 3.33 oz Formalin, 1 pint	60 F R. 65 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
22	Precip. 0 Cloudy	Pot. Perm. 3.33 oz Formalin, 1 pint	72 F R. 70 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
23	Precip. 0 Clear	Pot. Perm. 3.33 oz Formalin, 1 pint	72 F R. 70 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
24	Precip. .01 Cloudy	Pot. Perm. 3.33 oz Formalin, 1 pint	66 F R. 65 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
25	Precip. .01 Cloudy	Pot. Perm. 3.33 oz Formalin, 1 pint	70 F R. 68 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
26	Precip. .11 Partly cloudy	Pot. Perm. 3.33 oz Formalin, 1 pint	67 F R. 69 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
27	Precip. 0 Clear	Pot. Perm. 3.33 oz Formalin, 1 pint	71 F R. 66 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
28	Precip. 0 Clear	Pot. Perm. 3.33 oz Formalin, 1 pint	67 F R. 70 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
29	Precip. 0 Clear	Pot. Perm. 3.33 oz Formalin, 1 pint	63 F R. 66 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
30	Precip. .01 Cloudy	Pot. Perm. 3.33 oz Formalin, 1 pint	68 F R. 66 F	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.

*Temperature indicated by "R" is the temperature of the room.
Temperature first given is out-of-door temperature.

The results of these experiments, conducted under varying atmospheric conditions and with wide range of temperature, indicate that we have finally found a method of formaldehyde disinfection which will prove effective under any reasonable conditions. It has been the experience of the State Board of Health that formaldehyde, however generated, fails to accomplish satisfactory results at a temperature below 60 degrees F. While in the foregoing tables, it is shown that good results were obtained at 66 degrees, it has not been determined as to what the effect of lower temperatures will be with this method of generation. Tests will be made during the winter of 1906 to determine this point, but in the meantime the Board continues to advise the use of sulphur for disinfection in lower temperatures than 60 degrees.

It will be noted in the tables of laboratory tests that the bacterial growth was entirely destroyed when 6½ oz. of potassium permanganate were used with 1 quart of formalin to the 1,000 cubic feet of air space and that equally satisfactory results were obtained when 3½ oz. of potassic salts were used with 1 pint of formalin. It may consequently be stated that, under ordinary conditions of house disinfection, the room being well sealed, a pint of formaldehyde solution with 3½ oz. of potassium permanganite will be ample for 1,000 cubic feet of air space. With these amounts bacterial cultures enclosed in from one to four layers of flannel or cotton cloth were destroyed, these cultures including the bacillus subtilis (hay bacillus) known to be especially resistant to disinfection. It is not yet determined how small quantities of formalin and permanganate of potassium will produce satisfactory results, but it is the part of wisdom not to economize in materials if there is the slightest danger of reducing the germicidal power. Even with the largest quantities named, a quart of formalin to 6⅔ oz. of potassium permanganate, the cost is small.

The reason for the peculiar efficiency of formaldehyde generated by this method is probably that it reaches its maximum of disinfecting power in a very few moments, the gas being given off in immense volume and the whole reaction taking place within a very brief space of time. It is not at all improbable that bacteria which would withstand a similar quantity of formaldehyde gas if generated very slowly, yield to the gas exhibited in this highly concentrated form.

The following suggestions are important and may prevent failure in the application of this method:

Good formaldehyde is essential to success. Reliable formaldehyde or formalin is not expensive; poor formaldehyde is dear at any price. (See remarks on page 12.)

The fine needle-shaped crystals of permanganate of potassium are better than the large octohedral crystals.

Properly sealing the room, to prevent the escape of the gas, is almost as important as securing a proper disinfectant.

The disinfection of the room, the woodwork, furniture and floors, with liquid disinfectants, as described on page 5, is as important in using this method of disinfection as in any other.

The retention of heat, caused by the chemical reaction of the chemicals, is necessary to the generation of a large volume of gas. Hence, the protection of the metal container or generator by a coating of asbestos or with a non-conductive outer vessel is important.

Pour the formaldehyde over the potassium permanganate. Do not drop the permanganate into the formaldehyde.

While smaller quantities of chemicals and shorter amount of time of disinfection *may* prove sufficient, it is not the part of wisdom to reduce the quantities or the time.

The State Board of Health now feels justified in recommending formaldehyde for use in disinfection after contagious diseases, if employed by the method described, with potassium permanganate and the 40 per cent. aqueous solution of formaldehyde and it is the belief of the Board that, in properly sealed rooms, positive and reliable disinfection can be secured by the use of 3½ ounces of potassium permanganate and 1 pint of formaldehyde solution to the 1,000 cubic feet of air space.

Published by order of the State Board of Health.

JAMES A. EGAN, M. D., Secretary.

January 2, 1906

STANDARD DISINFECTANTS

The following are simple, cheap and most reliable disinfectants:

STANDARD DISINFECTANT No. 1.

Four per cent solution Chloride of Lime

Dissolve Chloride of Lime of the best quality, in water, in proportions of six ounces of lime, to one gallon of water.

This is one of the strongest disinfectants known. Discharges from the bowels of a patient suffering from a contagious or infectious disease, should be received in a vessel containing this solution, and allowed to stand for an hour or more before being thrown into the vault or water closet. Discharges from the throat or lungs should be received in a vessel containing this solution.

Chloride of Lime in powder may be used freely in privy vaults, cess pools, drains, sinks, etc.

Instead of the solution of chloride of lime, carbolic acid may be used for the same purposes, in a strenght of 6½ ounces to the gallon of water. This makes a 5 per cent solution of carbolic acid.

STANDARD DISINFECTANT No. 2.

Bichloride of Mercury, 1-500.

Dissolve Corrosive Sublimate and Muriate of Ammonia in water, in the proportion of two drachms (120 grains,—¼ ounce) of each to the gallon of water. Dissolve in a wooden tub, barrel or an earthen crock.

Use for the same purpose and in the same way as No. 1. Equally effective but slower in action, so that it is necessary to let the mixture (disinfectant and infected material) stand about four hours before disposing of it. This solution is odorless, while the chloride of lime solution is often objectionable in the sick room on account of its smell.

STANDARD DISINFECTANT No. 3.

Bichloride of Mercury, 1-1000.

Dissolve one drachm (60 grains,—⅛ ounce) each of corrosive sublimate and muriate of amonia in one gallon of water. Dissolve in a wooden tub, barrel or pail or earthen crock.

Used for the disinfection of soiled underclothing, bed linen, etc., immerse the articles for four hours, then wring them out and boil them. This solution is excellent for wetting the floors of offices, stores, workshops, halls and school rooms before sweeping.

Mixed with an equal quantity of water this solution is useful for washing the hands and general surfaces of the bodies of attendants.

☞ Chloride of lime, carbolic acid and corrosive sublimate are deadly poisons.

Milk of Lime (Quicklime.)

Slack a quart of freshly-burnt lime (in small pieces) with three-fourths of a quart of water—or, to be exact, 60 parts of water by weight with 100 of lime. A dry powder of slack lime (hydrate of lime) results. Make milk of lime not long before it is to be used by mixing one part of this dry hydrate of lime with eight parts (by weight) with water.

Air-slacked lime is worthless. The dry hydrate may be preserved some time if it is enclosed in an air-tight container. Milk of lime should be freshly prepared, but may be kept a few days if it is closely stoppered

Quicklime is one of the cheapest of disinfectants. The solution can take the place of chloride of lime, if desired. It should be used freely, in quantity equal in amount to the material to be disinfected. It can be used to whitewash exposed surfaces, to disinfect excreta in the sick room or on the surface of the ground, in sinks, drains, stagnant pools.

IMPORTANT NOTICE.

The Illinois State Board of Health has published a circular (now in a fifth edition) on the **CAUSE AND PREVENTION OF CONSUMPTION**, a preventable and curable disease, but one which kills over 8,000 persons in Illinois every year; kills men and women in their prime.

This circular contains chapters on the following subjects: THE CAUSE OF CONSUMPTION, THE SYMPTOMS OF CONSUMPTION, HOW TO AVOID CONSUMPTION, HOW THE SPUTUM MAY BE DESTROYED, IF YOU HAVE CONSUMPTION, THE HYGEINE OF THE SICK-ROOM, CONSUMPTION IN SCHOOLS, AS TO CHANGE OF CLIMATE AND AS TO THE TREATMENT OF CONSUMPTION IN ILLINOIS.

Copies of this circular will be sent free of charge to any person who applies to the Secretary at Springfield.

It is believed that if a copy of this circular could be placed in every home in which there is a consumptive patient, the ravages of consumption would be greatly reduced in a few years.

"We have received a copy of a circular just issued by the Illinois State Board of Health on '**The Cause and Prevention of Consumption.**' We regard it as the most complete and compact statement of the cause and prevention of this all-too-universal and fatal disease that we have seen. If a copy of it could be put into every home in the land and was read and its precepts heeded, Consumption would be reduced fifty per cent. in ten years."—From Iowa Health Bulletin, August, 1904, published by the Iowa State Board of Health.

"Among the sanitary organizations that really do something toward providing the people with information we must accord a high place to the Illinois State Board of Health, a body to which both the medical profession and the population at large are deeply indebted. The Board's circular on the Cause and Prevention of Consumption, first issued in July, appears now in the form of a third edition. We learn that the demand for copies of this circular, not only in Illinois, but also in almost every State of the Union, has been remarkable. This is not to be wondered at when we reflect upon its simple and cheering words to consumptives.—(New York Medical Journal and Philadelphia Medical Journal.)

"The Illinois State Board of Health is performing excellent service to the people of this State through the publication and wide distribution of its pamphlet on Consumption, the fourth edition of which was issued recently. In small space the questions of cause and prevention are handled from all possible points of view. The reader is not left in doubt as to the situation the consumptive is in nor as to the certain methods he must adopt would he successfully battle with the insidious foe. Figures are given in judicious measure to reveal the strength of this terrible enemy of mankind and to force the conclusion that there must be determination on the part of victims and co-operation on the part of agencies interested in the cause, if any telling advance in prevention and cure is to be made-"—CO-OPERATION.